

REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1, 3-7, 9 and 11-12 are currently pending in this application. No new matter been amended by way of the present amendment. For instance, the amendment to claim 1 finds support in the Specification at, for example, page 4, lines 1-3 and page 7, lines 12-13. Accordingly, no new matter has been added.

At the outset, the present application is believed to be in condition for allowance. Entry of the accompanying amendment is requested under 37 C.F.R. §1.116, as the amendment does not raise any new issues which would require further search and/or consideration by the Examiner. Furthermore, Applicants request entry of this amendment in order to place the claims in better form for consideration on Appeal.

In view of the remarks herein, Applicants respectfully request that the Examiner withdraw all outstanding rejections and allow the currently pending claims.

Issues Under 35 U.S.C. 103(a)

Claims 1, 3-7, 9 and 11-12 remain rejected as being unpatentable over Stine et al. (U.S. 5,847,252) (hereinafter Stine '252) in view of Lyman et al. (U.S. 2,135,823) (hereinafter Lyman '823). Applicants respectfully traverse.

The Examiner stands by his previous position that the cited prior art renders the present invention obvious. The Examiner maintains that Stine '252 discloses a process for producing a motor fuel component that comprises paraffins, wherein the process comprises hydrotreating an olefinic stream obtained from a process in which butenes are dimerized. The Examiner further

argues that the reactants flow downward through the catalyst beds, thus making the reactor of Stine '252 a trickle bed reactor.

The Examiner acknowledges that Stine '252 fails to disclose several limitations of the present invention, but relies on the teachings of Lyman '823 to establish that it would have been obvious to one of ordinary skill in the art to modify Stine '252 by: 1) utilizing a liquid feed for the hydrogenation process; 2) utilizing a sulfur-containing stream; 3) using a feed containing the olefin types and amounts claimed; 4) using catalyst metal amounts as presently claimed; and 5) using "conditions as claimed in the process of Stine because such conditions are within the ranges disclosed by Stine".

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Additionally, there must be a reason why one of ordinary skill in the art would modify the reference or combine reference teachings to obtain the invention. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. *KSR Int'l Co. v Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007). There must be a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. *Id.* The Supreme Court of the United States has recently held that the "teaching, suggestion, motivation test" is a valid test for obviousness, albeit one which cannot be too rigidly applied. *Id.* Rejections on obviousness grounds cannot be sustained by mere

conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *Id.*

Stine '252 fails to teach or suggest a process as presently claimed. Specifically, Stine '252 fails to disclose or suggest the following limitations, among others:

- 1) a hydrocarbon feed in the liquid phase;
- 2) the use of a trickle bed reactor;
- 3) the presently claimed feed composition (i.e., a feed containing sulphur);
- 4) a concentration of less than 1wt% of the noble metal in the noble metal catalyst; and
- 5) the presently claimed reactor conditions in each reactor, including a higher temperature in the second step (compared to the first step).

The Examiner maintains his position that Stine '252 discloses trickle bed reactors. The Examiner refers to the schematic figure of Stine '252 and claims that the reactants flow downward thus making the reactor a trickle bed reactor. Applicants respectfully and strongly disagree.

It remains unclear on which basis the Examiner assumes that the reactors of Stine '252 are trickle bed reactors, **as Stine '252 is silent about trickle-bed reactors, which are used with liquid feed** (emphasis added).

There is absolutely no disclosure in Stine '252 with regard to the reactor being a trickle bed type reactor. In the contrary, the specification clearly teaches that the reactants are in the gas phase, making it impossible to use a trickle bed reactor, which requires a liquid phase and a gas phase present. The figure cited by the Examiner merely describes a basic type of hydrogenation reactor.

Trickle-bed reactors are three-phase reactors vastly used in industrial applications. The operation principles differ significantly from the operating principles of gas phase reactors. **It is essential to use liquid feedstock in connection with trickle-bed reactors** (emphasis added). Gaseous hydrocarbon feed cannot be used in connection with trickle-bed reactors.

As noted in multiple previous occasions, a gas phase reactor may certainly operate in downflow mode; however, **downflow alone does not turn a gas phase reactor into a trickle bed reactor**. A characteristic and essential feature of a trickle bed reactor, in addition to downward flow, is the presence of both liquid and gas phases in the reactor. The very name of this type of reactor type is based on this characteristic: the liquid phase “trickles” down through the catalyst bed.

As discussed in the Declaration submitted on June 26, 2007, the fluid in Stine '252 is supercritical. This means that there simply cannot be any liquid phase present in the reactor. Stine '252 explicitly states: “the reaction conditions are selected to keep the hydrocarbon feed in a vapor phase” (Stine '252, column 14, lines 33-34). If the reactor feed is in a vapor or supercritical phase, the heavily exothermal hydrogenation reactions will only bring the mixture further away from conditions where condensation is possible. Thus, it is absolutely clear that the reactors of Stine '252 cannot have the most characteristic feature of a trickle bed reactor: there is no liquid phase present. Therefore, the reactors of Stine '252 are not trickle bed reactors. Thus, Stine '252 cannot possibly teach or suggest the use of trickle bed reactors in a process as defined in the present claims.

In order to carry out a trickle bed operation in the process of the present invention, it is essential that supercritical conditions be avoided. This is accomplished by:

- 1) excluding the C₄ hydrocarbons from the saturation reactor feed, and

2) limiting the maximum temperature below 300°C, thus making trickle bed operation possible.

These differences of the feed are substantial and critical, and result in significant differences in reactor design and operation.

Stine '252 recommends two particularly applicable groups of catalysts. The first group consists of catalysts containing only nickel as an active component. The second group consists of catalysts containing a combination of nickel or cobalt with molybdenum. It should be noted that Stine '252 does not mention noble metal catalysts as a preferred choice, but rather mentions these in passing only, as general information and for completeness. The preferred catalysts for saturation according to Stine '252 are nickel or Co-Mo or Ni-Mo catalysts.

Further, in the process according to Stine '252, light olefins (C_7 or lighter) (stream 58 in the figure) are circulated. The end result is that the feed to the hydrogenation zone contains high amounts of light olefins, thus making gas phase hydrogenation the only feasible alternative in a process such as Stine's.

The process according to Stine '252 requires high amounts of fresh hydrogen if no hydrogen circulation is used. When hydrogen circulation is used, special arrangements are needed in order to carry out the circulation (e.g., a hydrogen recycle compressor, which is an expensive special piece of equipment, becomes necessary).

Moreover, the hydrogenation conditions of Stine '252 require expensive special materials because of potential corrosion. Thus, the gas phase hydrogenation stage according to Stine '252 results in an expensive process.

In contrast, when a trickle-bed reactor is used in the process according to the present invention no circulation of hydrogen is needed, hydrogen losses are unsubstantial, and the catalyst is always covered by liquid, which results in significantly better local control of temperature. Investment costs are significantly smaller when compared with gas phase reactors and no special materials are needed in the equipment.

Evidently, Stine '252 fails to teach or suggest a process as claimed. Lyman '823 fails to cure these deficiencies.

The Examiner quotes four passages of Lyman '823 to support his assertion that Lyman '823 cures the deficiencies of Stine '252. The first quoted paragraph is on page 4, lines 20-35. In this paragraph, Lyman '823 discloses that the olefin feed may contain sulphur containing substances, which have no effect on the phosphoric acid film catalysts (the acidic polymerization catalyst). Sulfur compounds of acidic nature, such as hydrogen sulphide or the mercaptans, are condensed with an olefin double bond during the polymerization and result in sulphur bodies in the product which are extremely difficult to remove. Thus, washing the gas with an alkaline solution prior to passage over the polymerization catalysts is desirable.

As is well known in the art, the alkaline wash typically removes the sulphur before the polymerization stage. **As a result, the feed to the hydrogenation stage would be free of this type of sulphur** (emphasis added).

Lyman '823 further discloses on page 5, first column, lines 48-61, that high sulphur polymers (polymers containing high amounts of sulphur impurities) may be hydrogenated with molybdenum containing sulphur insensitive catalysts. Evidently, Lyman '823 explicitly teaches

the use of molybdenum containing a **non-noble metal catalyst** (emphasis added) for sulphur containing feeds.

Furthermore, on page 5, second column, lines 37-48, Lyman '823 discloses that isomeric butanes are polymerized and the polymers are hydrogenated. Applicants note that Lyman '823 was filed in 1936, when the requirements for fuels were completely different from present day requirements. For instance, there were no specific limits for sulphur compounds, as long as the fuel was suitable for an engine. One skilled in the art would not expect the feeds of Lyman '823 to provide suitable products if used in the process of Stine '252. Moreover, there is absolutely no evidence that the sulphur components could or would be removed completely, as Lyman '823 recommends different alternatives suited for different conditions: 1) using an active, nickel-containing catalyst if a low sulphur feed is used; 2) using catalysts containing molybdenum if a high sulphur feed is used; and, 3) washing the feed gas with an alkaline solution prior to passage over the polymerization catalysts if the feed contains sulfur compounds of acidic nature.

A skilled man in the art, faced with the teachings of Stine '252 and Lyman '823 would obviously select the latter alternative of Lyman '823, and the result would be entirely different from the present invention. Thus, the combination of Stine '252 and Lyman '823 would be outside the scope of the present invention.

Evidently, Stine '252 in view of Lyman '823, fails to teach or suggest a process as claimed. For this reason alone, this rejection should be withdrawn. Furthermore, assuming *arguendo* that Lyman '823 cured the deficiencies of Stine '252, it is noted that references cannot be arbitrarily combined. There must be some reason why one of ordinary skill in the art

would be motivated to make the proposed combination of the primary and secondary references. *In re Nomiya*, 184 USPQ 607 (CCPA 1975). Courts have clearly established that, even when a combination of references teaches every element of a claimed invention, a rejection based on a *prima facie* case of obviousness is improper absent a motivation to combine. *In re Rouffet*, 149 F.3d 1350, 47 USPQ2d 1453 (Fed. Cir. 1998).

Lyman '823 explicitly teaches how to treat a feed containing sulphur; Stine '252 does not. Thus, a skilled person designing a process to treat a feed containing sulphur, based on these references, would obviously select the alternative of Lyman '823 and the result would be different from the current invention. One skilled in the art would not have been motivated to modify Lyman '823, as this would require acting against the teachings of the reference.

Additionally, Applicants submit that the present invention achieves superior and unexpected results over the prior art. The combination of Stine '252 and Lyman '823 gives a clear picture of the current level of technology: nickel-based hydrogenation catalysts are used for very low sulphur feeds, and molybdenum-containing hydrogenation catalysts under severe conditions are preferred if sulphur is present. This is not only a theory, but is indeed the current industrial practice.

Thus, Applicants' discovery that a noble metal catalyst is efficient in this application under the moderate reaction conditions presently claimed is highly unexpected. Moreover, Applicant's finding that the noble metal catalysts tolerate these conditions while still efficiently removing sulphur compounds, reaching levels below 0.1 ppm, and simultaneously hydrogenating the olefins (particularly because the sulphur compounds present are relatively stable compounds) is unexpected.

Conventional catalysts used for removing sulphur compounds are applied at significantly

higher temperatures under gas phase, are rapidly deactivated and do not affect hydrogenation of olefins. Typically, sulphur levels of around 10 ppm are achieved; levels below 1 ppm are very difficult to achieve. The Examiner's attention is respectfully directed to the attached "*Gasoline Fuel Specifications for United States (2008)*", which shows that sulphur levels in the United States are in the range of 80 ppm (15 ppm in California). Thus, Applicants submit that the extremely low level of sulphur achieved by the present process is an unexpected and superior result over the prior art of record.

Clearly, the present invention is not disclosed or made obvious by the cited prior art. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and objections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Vanessa Perez-Ramos, Reg. No. 61,158 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

By 

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Enclosure: *Gasoline Fuel Specifications for United States, for year 2008*

Gasoline Fuel Specifications for United States, for year 2008

Last updated on December 4, 2008

	ASTM	U.S.		California			
Year of Implementation	May, 2007	Jan, 2007	Jan, 2000	Jan, 2003			
Spec Name	ASTM D 4814-07	Conventional (1)	Federal RFG (2)	California RFG Phase 3			
Grade	Unleaded	All	Phase II	CaRFG3 (3)			
Additional Comment				Flat Limits (4)	Averaging Limits (5)	Cap Limits (6)	
Source	ASTM, EPA	EPA, ASTM		13 California Code of Regulations 2250-2273			
Property							Test Method
Antiknock Index (MON+RON)/2, calculated, min	(7)			(8)			ASTM D 2885
Sulfur, ppm, max	80 (9)	80 (10)		20	15	30	ASTM D 5489, ASTM D 4045
Lead, g/l, max	0.013 (11)	0.013 (1)	0.013 (12) (2)	0.013 (13)			ASTM D 3237, ASTM D 3341, ASTM D 5059
Manganese, g/l, max		0.0083 (13)	0 (13)	0 (14)			
Benzene, vol%, max		(15)	1 (16)	0.8	0.7	1.1	ASTM D 5580
Aromatics, vol%, max				25	22	35	ASTM D 5580
Olefins, vol%, max				6	4	10	ASTM D 6550 (modified)
RVP @ 37.8°C (100°F), kPa, min		44 (17)	44 (18)	44 (19)	44 (19)(20)	44 (19)	ASTM D 323, ASTM D 4963, ASTM D 5190, ASTM D 5191, ASTM D 5482
RVP @ 37.8°C (100°F), kPa, max	103 (21)	75 (17)	69 (18)	48.3 (19)(22)	48.3 (19)(22) (20)	50 (19)	ASTM D 4963, ASTM D 5190, ASTM D 5191, ASTM D 5482
Distillation	DI=569 - 597 (23)	(24)					ASTM D 86
T10, °C, max	70 (25)						
T50, °C, min	66 (25)				-	104	
T50, °C, max	121 (25)				100.5 (26)	95 (27)	
T90, °C, min					-	166	
T90, °C, max	190 (25)				151.6 (28)	146.1 (29)	
FBP, °C, max	225						
Residue, vol%, max	2						
Oxygen, wt%, min				1.8 (30)	1.8 (30)(31)	1.8 (30)	ASTM D 4815
Oxygen, wt%, max				2.2	2.2 (31)	3.5 (32)	ASTM D 4815
Oxygenates, vol%, max				(33)			ASTM D 5599, ASTM D 4815
Phosphorus, g/l, max	0.0013 (11)	0.0013 (1)	0.0013 (2)	0.0013 (3)			ASTM D 3231
Oxidation stability (Induction period), minutes, min	240				240 (3)		ASTM D 525
Existent gum (solvent washed), mg/100ml, max	5				5 (3)		ASTM D 381

Copper corrosion, 3 hr @ 50°C, merit (class)	No. 1			No. 1 (3)	ASTM D 130
Use of additives	(34)	(35)		(34)(33)	
Other	(36)(37)	(38)(39)	(37)(40) (41)		

Notes:

1. Applicable ASTM D 4814 specifications and EPA regulations are applied to conventional U.S. gasoline specifications.
2. Applicable ASTM D 4814 specifications and EPA regulations are incorporated into Federal RFG specifications.
3. ASTM D4814 and applicable EPA regulations are incorporated into these specifications.
4. Under this primary compliance option for producers and importers of California RFG, all batches of gasoline must meet these requirements.
5. Under this alternative compliance option for producers and importers of California RFG, these requirements must be achieved as a refiner/importer volume-weighted average of gasoline supplied in California. Designated Alternative Limits (DALs), or cap limits per batch may be agreed upon with the California Air Resources Board under this compliance option.
6. All gasoline in California must meet these limits at all points in the supply chain.
7. Octane limits are set and regulated at the state level; the industry (R+M)/2 standard is generally 87/89/91+ for regular, midgrade and premium. Certification and posting of octane ratings regulated by Federal Trade Commission under 16 Code of Federal Regulations (CFR) 306.
8. Octane levels are not regulated, but the industry (R+M)/2 standard is 87/89/91+ for regular, midgrade and premium. Certification and posting of octane ratings regulated by Federal Trade Commission under 16 CFR 306.
9. ASTM standard is based on operability, while EPA requires more stringent sulfur restrictions under the Tier 2 regulations to 80 ppm (per gallon cap) based on environmental considerations. EPA includes a limit for the refinery average of 30 ppm. The EPA sulfur requirements exclude Geographic Phase-In Area and small refiners.
10. Per-gallon cap per EPA regulation (65 FR 6698; 2/10/00). The refinery average is 30 ppm. Excludes Geographic Phase-In Area and small refiners.
11. Leaded gasoline has been banned in the U.S. by EPA since 1996. Per EPA regulation (59 FR 7716; 2/16/94), no intentional addition of heavy metals allowed. While ASTM has no limit, EPA limits the phosphorus content of gasoline to a maximum of 0.0013 g/L. The regulations do not prohibit lead additives in aircraft, racing cars, and off-road farm & marine engines.
12. Per U.S. Environmental Protection Agency (EPA) regulation (59 FR 7716; 2/16/94), no intentional addition of heavy metals allowed.
13. Per EPA regulation (59 FR 7716; 2/16/94), no intentional addition of heavy metals allowed without a waiver from EPA.
14. Manganese authorized for use as a consumer additive.
15. Per EPA regulation (66 FR 17230; March 29, 2001), refiners are required to maintain 1998 - 2000 level toxic emission performance.
16. For annual average option, 1.30 vol% and 0.95 vol% annual average.
17. RVP requirements vary by season and region.
18. Varies by season and region; RVP compliance based on VOC performance standard, min no lower than 6.4 psi (44 kPa).
19. RVP standards apply only during warmer months as identified in 13 CCR 2262.4.
20. RVP does not have an averaging option, producers and importers of CaRFG must meet the Flat Limit.
21. ASTM advises to consult EPA for approved test methods for compliance with vapor pressure regulations. RVP varies by season and region. See EPA regulation (54 FR 11868; 3/22/89).
22. A 6.90 psi (47.6 kPa) flat limit applies, but only when a producer or importer is using the evaporative emissions model element of the CaRFG Phase 3 Predictive Model, in which case all predictions for evaporative emissions increases or decreases made using the evaporative emissions model are made relative to 6.90 psi and the gasoline may not exceed the maximum RVP cap limit of 7.20 psi (49.8 kPa). Where the evaporative emissions model element of the CaRFG Phase 3 Predictive Model is not used, the RVP of gasoline sold or supplied from the production or import facility may not exceed 7.00 psi (48.3 kPa).
23. Drivability Index limits are applicable at the refinery or import facility per 40 CFR 80.2 and are not subject to correction for precision of the test method.
24. Anti-dumping and RFG programs use models with equations to determine compliance with specific fuel performance targets (VOC, toxics, NOx). Ranges are established for E200 and E300 (distillation fraction of target fuel in terms of vol%) for each target. See 40 CFR 80.90 for equations and specific target ranges.
25. Volatility requirements vary by season and region.
26. 213 degrees Fahrenheit
27. 203 degrees Fahrenheit
28. 305 degrees Fahrenheit
29. 295 degrees Fahrenheit
30. 1.8 wt% min oxygen content applies during specified winter months in the areas identified 13 CCR 2262.5(a). Under the Predictive Model, zero oxygen may be used in areas that are not extreme or severe federal ozone nonattainment areas.
31. There is no averaging limit for oxygen content; refiners and importers must comply with the Flat Limit for CaRFG.
32. If gasoline contains more than 3.5 wt% oxygen but no more than 10 vol% ethanol, the max oxygen content cap is 3.7 wt%.
33. MTBE was officially prohibited in Jan. 2004.
34. All gasoline sold in the U.S. must contain a deposit control additive.
35. Gasoline must contain a deposit control additive.
36. Not shown above is a silver strip corrosion specification of No. 1 max.
37. This specification requires that gasoline have a maximum Vapor-Liquid Ratio of 20 per ASTM D 2533. The test temperature varies between 35°C and 60°C depending on the vapor lock protection class.
38. This specification also requires that the volume of fuel evaporated at 200 degrees F be between 30 and 70 vol% or be below

the importer/refiner's 1990 baseline, whichever is higher.

39. This specification also requires that the volume of fuel evaporated at 300 degrees F (E300) be between 70 and 100 vol% or be below the importer/refiner's 1990 baseline, whichever is higher.
40. This specification also requires that the volume of fuel evaporated at 200 degrees F (E200) be between 30 and 70 vol% per ASTM D86.
41. This specification also requires that the volume of fuel evaporated at 300 degrees F (E300) be between 70 and 100 vol% per ASTM D86.